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PHSB STUDIES

A Special Report Series by the N.C. Department of Human Resources, Division of Health Services, Public Health Statistics Branch, P.O. Box 2091, Raleigh, N.C.

No. 8 February 1978

TIME VARIATIONS IN NORTH CAROLINA BIRTHS, 1974-76

Interest in patterns of vital events has prompted considerable research in this area. Results show that factors such as season of year, day of week, and time of day affect the occurrence of births and certain causes of mortality (1,2). Some researchers even suggest that lunar phases influence the timing of events (3).

In light of this research, a study was conducted using North Carolina birth data for 1974-76 to determine if differences occur in the distribution of births by certain variables of time. Births by day of week, month and season of year, and lunar phase were examined, and chi-square tests were applied to the data to detect statistical significance.

Births by Day of Week

The maximum number of births in the United States occurs near midweek (1). An analysis of North Carolina births for a three-year period supports this finding; more babies arrived on Tuesday than on any other day.

Had each day of the week occurred an equal number of times during the three years, one would expect approximately the same number of births to occur each day, Monday through Sunday. Such, however, is not the case; even after adjustment for an equal number of days, large disparities exist in numbers of births per day. The weekends are particularly different from the weekdays.

Table 1 shows adjusted daily totals of North Carolina resident live births during 1974-76. Almost 19 percent more births occurred on Tuesday than on Sunday, the day with the fewest births. The next smallest number of births occurred on Saturday while Friday ranked second in highest number of births.

Table I

Resident Births by Day of Week by Race

North Carolina, 1974-76

Day of Week	Total	White	Nonwhite
Sunday	31,190	20,525	10,665
Monday	35,982	24,565	11,417
Tuesday	37,114*	25,666*	11,448*
Wednesday	35,839*	24,813*	11,026*
Thursday	35,750*	24,618*	11,132*
Friday	36,252*	25,123*	11,129*
Saturday	32,624	22,044	10,580

*A total of 157 Tuesdays, Wednesdays, Thursdays, and Fridays occurred during 1974-76. These days were adjusted to 156-day bases in order to maintain comparability.

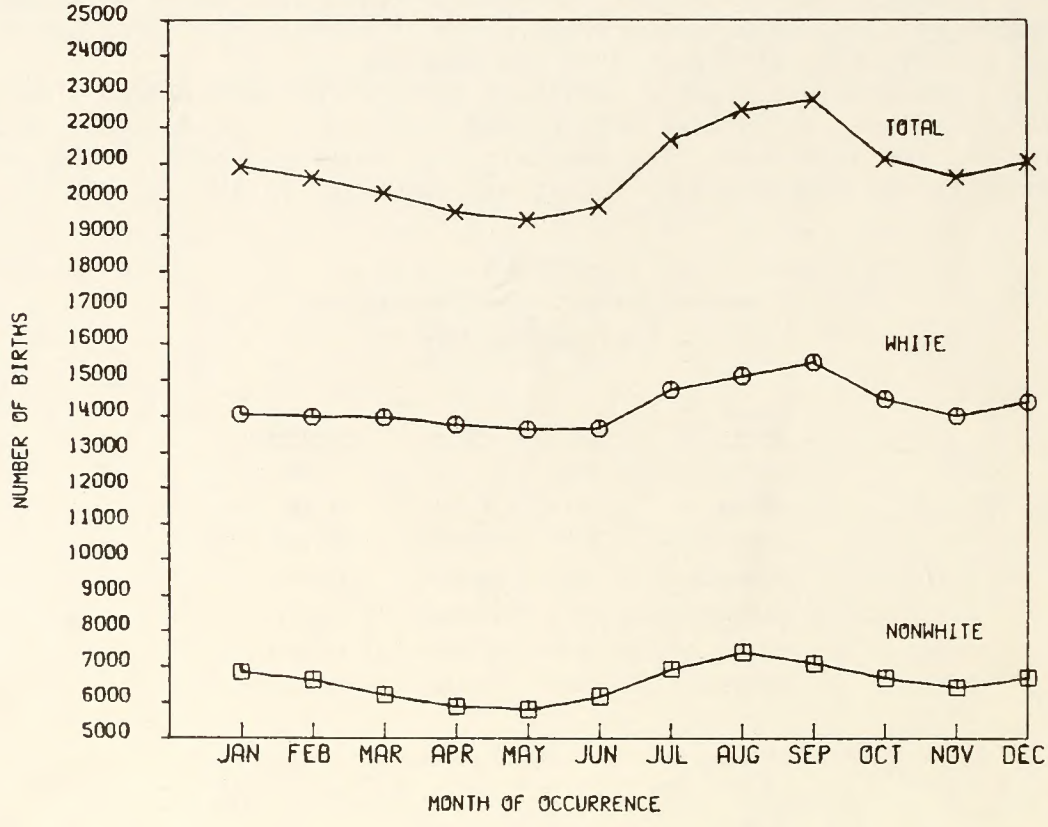
Tuesday, Saturday and Sunday maintained the same rank during each of the three years. The ranks of the other days, being more equal in number of births, fluctuated during this period. Chi-square tests applied to the data show that the difference between observed number of births for each day of week and the expected number (based on the mean number of births per day during the three years) was significant ($P < .01$, 6df).

The data by race show a similar trend for whites, but the trend is slightly different for nonwhites. Nonwhite births are more evenly distributed than white births. An 8 percent difference exists between the high and low for nonwhites as opposed to a 25 percent difference for whites. The variation in the number of births by day of week was again statistically significant ($P < .01$, 6df) for both whites and nonwhites.

Births by Month and Season

Large disparities in number of births by month have long been observed in the United States and other countries (4,5). North Carolina also experienced monthly variation in births as can be seen in Figure 1. This figure compares 1974-76 births by month after the adjustment of February, April, June, September and November to 31-day bases for each year. September and August, the months with the largest number of births, together claimed 16 percent more births than April and May, the months with the fewest births.

FIGURE 1
RESIDENT LIVE BIRTHS BY MONTH
NORTH CAROLINA 1974-1976



North Carolina data are consistent with national trends which show that more births occur in late summer while fewer births occur in late spring (4). A similar pattern exists for each of the years involved and for both races. However, unlike births by day of week, nonwhite births are less randomly distributed by month than white births. A 28 percent difference exists between the high and low for nonwhites compared to a 14 percent difference for whites. Tests applied to the monthly variations in births show significance ($P < .01$, 11df) for both races, separately and combined.

Though the existence of seasonal patterns in births has been established, reasons for this occurrence have not been fully explained. Could it be that man, like other creatures on earth, is subject to an inherent pattern of conception? This theory was explored by Erhardt et al (7) who considered the existence of a biological rhythm in women. Such a rhythm would cause more conceptions to occur in late winter, in turn producing more summer births. To test this hypothesis, a slightly altered form of Erhardt's own analysis of conceptions in New York City was done. North Carolina legitimate and out-of-wedlock births by race for 1974-76 were examined; the assumption was that if a biological pattern did exist, it would be apparent for all marital groups.

For analytic purposes, the data for each month were adjusted to a 31-day base and the ratios of observed to expected births were computed. The average adjusted number of births per month during the three-year period for each group was used as the expected. Since monthly fluctuations were sometimes quite erratic, the data were smoothed in order to bring to surface any underlying patterns. The smoothing process involved computing two-month moving averages from the calculated ratios and plotting the averages between the months (Figure II).

Figure II shows seasonal patterns of births by marital status for the different ethnic groups. Although white legitimate births have slightly less monthly variability than the other groups, a consistent pattern of a rise in summer births and a decline of spring births is apparent in all ethnic groups with the exception of one group—out-of-wedlock births to races other than white and black. This group, on the contrary, reaches its peak in late winter and experiences two declines—one in late spring and one in the fall. Since births in this group are small in number, more variability is likely to occur, which could explain the inconsistency in this group.

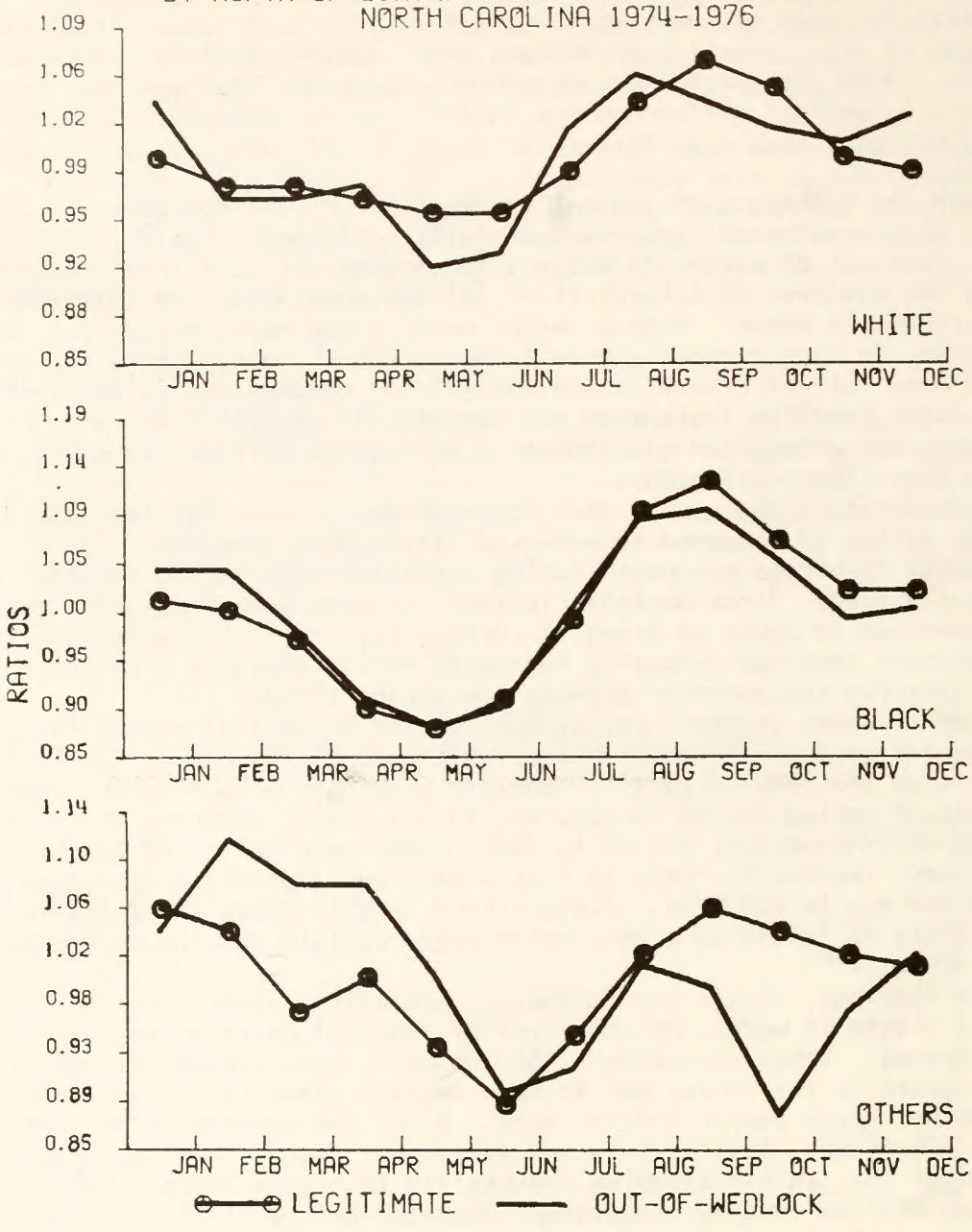
These findings, though not completely providing evidence for the existence of a biological rhythm in women, do show similar seasonal patterns in births for five of the six groups. Other researchers (8), however, have suggested that increased conception occurs in the winter due to more opportunities for sexual intercourse—that is, cold weather keeps people indoors more. Also, the occurrence of more social festivities (Christmas, New Year) in the winter may have a bearing on sexual activities.

Stoeckel (5), in his study on seasonality in births in East Pakistan, found that the mean minimum monthly temperature 9 months before birth was inversely related to the number of births. This observation suggests that temperature is a positive correlate of conception.

Births by Lunar Phase

The relationship of obstetrics and the moon has been pondered for centuries and has been the subject of various studies. These studies are not necessarily whimsical, but to a certain degree, are based upon scientific fact.

FIGURE II
AVERAGE RATIOS OF OBSERVED TO EXPECTED BIRTHS
BY MONTH OF BIRTH, ETHNIC GROUP AND MARITAL STATUS
NORTH CAROLINA 1974-1976



The moon exerts its influence on Earth in many ways. For instance:

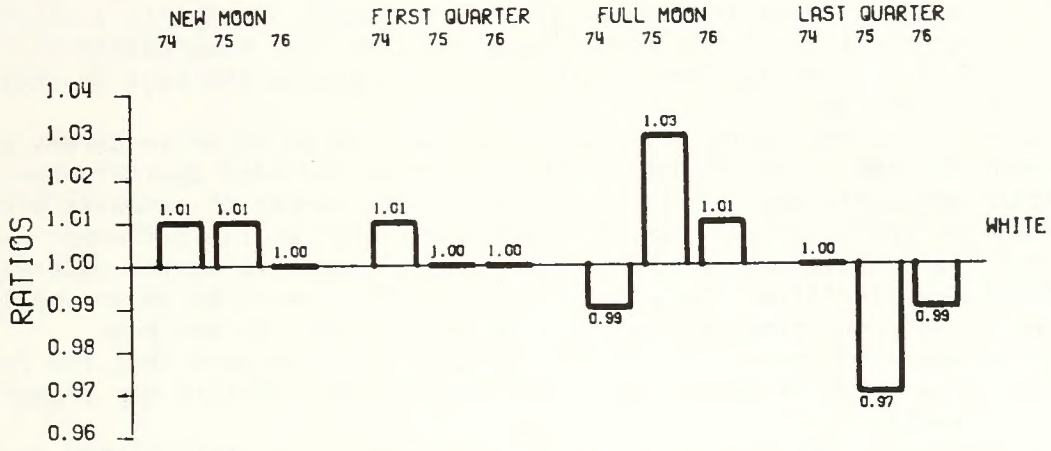
. . . the large movements of water on our planet—that is the ebb and flow of the tides—are caused by the moon's gravitational pull. Since this is so, it follows that these water movements do not occur only in the oceans, but that all bodies of water are affected, even down to the tiniest puddle.

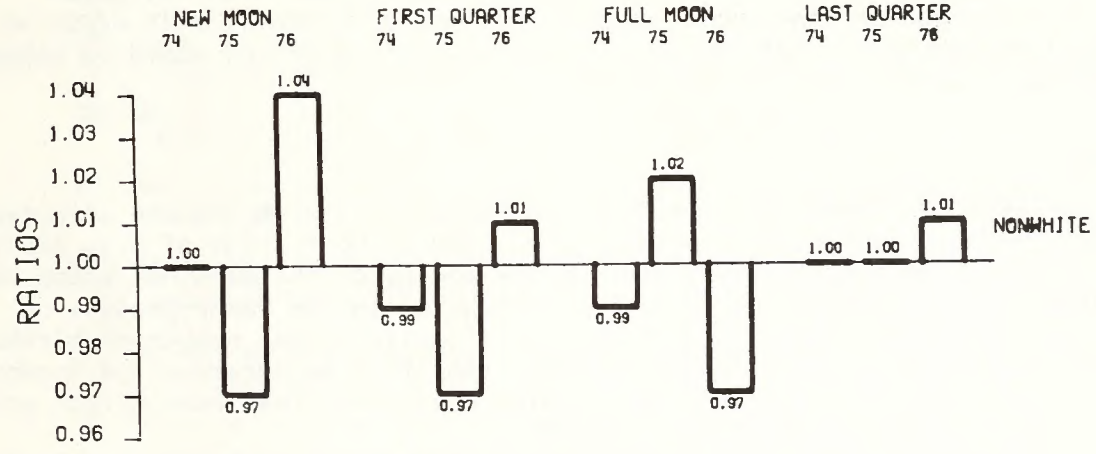
The human body, too, which consists of about 70 percent of water, falls within the scope of this lunar influence. . . . (9)

With this idea in mind, the 1974-76 North Carolina births were examined to determine if lunar phases were associated with frequency of delivery. The time

span used for each lunar period included the two days prior to the calendar day of each phase through the day after the calendar day. McDonald (10) claims that these time periods are associated with the maximum effect of the moon's gravitational pull on earth.

FIGURE III
RATIOS OF OBSERVED TO EXPECTED RESIDENT BIRTHS
OCCURING DURING LUNAR PHASES(4-DAY PERIODS)
NORTH CAROLINA 1974-1976





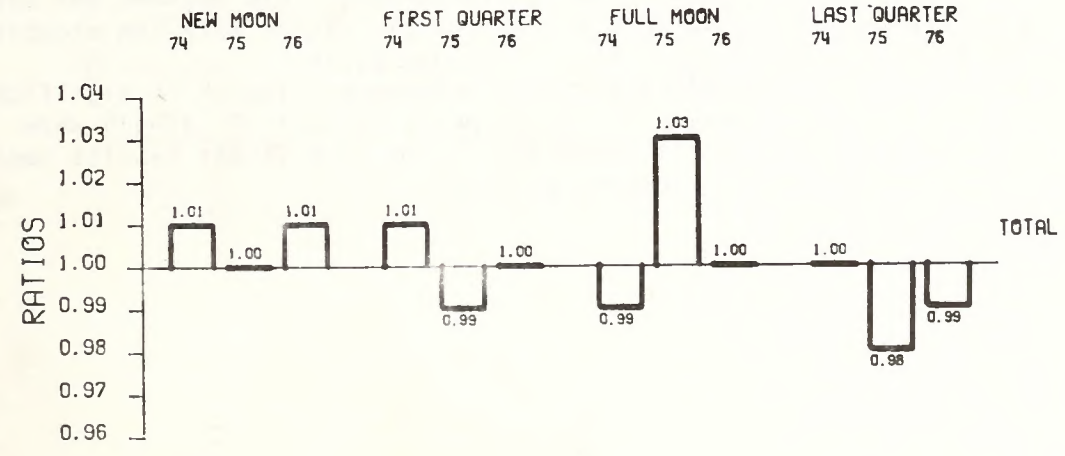


Figure III shows ratios of observed to expected births by race for the four-day lunar phase periods during each of the years 1974-76. Expected births were computed by multiplying the average number of births per day by the number of days in each phase period for each year. Although these ratios show no consistent pattern for any phase, large deviations from the expected number of births are apparent.

A chi-square analysis showed that the number of births occurring during the lunar phase periods was not significantly different from those occurring on all other days during 1974-76. Neither was significance found when the four-day periods of each phase were tested separately against all other days.

However, upon examining each year separately, births occurring during the phases of 1975 were significant ($P < .01$, 4df). This result was due to a significantly larger number of white births occurring during the Full Moon period ($P < .01$, 1df) and significantly fewer births occurring during the Last Quarter period of 1975 ($P < .01$, 1df).

Considering all three years together, again the number of white births proved to be significant for the phase periods of the Full Moon and Last Quarter when each phase was tested separately against all other days. The number of nonwhite births occurring during the phase periods, however, was not significantly different from those occurring on all other days of 1974-76. In fact, nonwhite births occurring during the phases were significant only for the year 1976, caused by an unusually large number of births occurring during the days surrounding the New Moon.

These findings, though not consistent for each year, suggest that the Full Moon may stimulate an onset of white births and the New Moon in turn may prompt an increase in nonwhite births.

Nonwhite gestation has been shown to be about two weeks shorter than that for whites. If the occurrence of the Full Moon is associated with increased frequency of menstruation, then more white births would be expected to occur 40 lunar weeks later, hence at Full Moon, while more nonwhite births would be expected to occur 38 lunar weeks later—at New Moon.

Conclusions

Researchers have long noted that the incidence of deliveries are affected by such environmental factors as season of year, day of week, time of day, temperature and climate. Superstition surrounding the phases of the moon has prompted investigation of the incidence of births occurring during the lunar phases.

In North Carolina during 1974-76, a significantly larger number of births occurred on Tuesday while significantly fewer births fell on Saturday and Sunday. This finding is consistent with national studies which show that more births occur during midweek and fewer occur on the weekend.

In addition, the largest onset of births occurred during August and September while a sharp decline in births occurred in April and May. This pattern was also apparent in legitimate and out-of-wedlock births for all races, with the exception of out-of-wedlock births to races other than white and black.

Births are also possibly subject to lunar influence. Though no significance was found when births occurring during the lunar phase periods of 1974-76 were tested against births occurring on all other days, some significant results were found when births were examined by race and by year.

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When each phase period was compared separately against all other days in 1974-76, births occurring to whites during the Full Moon phase were significantly greater while those occurring during the Last Quarter phase were significantly fewer than white births occurring on all other days. This significance was due to the proportion of white births occurring during the lunar phase periods of the year 1975. The occurrence of nonwhite births was not significantly affected by the lunar phases for the three-year period, but was significantly different for the phase period of the New Moon during 1976.

Though no unshakable explanations for patterns in births have been established, this study presents findings that show patterns do indeed exist. Whether socially, environmentally, or biologically controlled, patterns of vital events (both natality and mortality) perhaps warrant further investigation as an aid to understanding factors influencing man.

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